GLOSSARY

Background on the nature of risk and uncertainty analysis is presented at the end of this section.

adaptive management Adjusting project strategy as needed to achieve mitigation objectives while the project is being implemented.

advanced release An operational method that depends on weather forecasts to make reservoir release decisions in anticipation of the actual rainfall event.

adverse effects Unfavorable, harmful, or detrimental changes in environmental conditions caused by project or municipal activities.

aggradation 1) The buildup of sediment at the headwaters of a lake or reservoir, or at a point where streamflow slows to the point that it will drop part or all of its sediment load.
2) Modification of the earth's surface in the direction of uniformity of grade or slope, by deposition, as in a riverbed.

alluvial deposits Relating to material deposited by flowing water. Sedimentary formation composed of clay, sand, gravel, and other materials moved and deposited by streams and deposited by them.

ambient 1) The existing or background air, soil, water, or plant quality in a given community.
2) The allowable amount of materials, as a concentration of pollutants, in air, soil, water, or plants.

anadromous fish Fishes, such as salmon, steelhead, and shad, that inhabit marine waters during juvenile and adult life stages and migrate to fresh water to spawn.

Annual exceedance probability The probability that flooding will occur in any given year considering the full range of possible annual flood discharges.

armored; armoring A facing layer or protective cover of concrete structural features placed to prevent erosion or the sloughing off of an embankment. Also, a layer or large stones, broken rocks or boulders, or precast blocks placed in specific random fashion on a river to protection against flowing water.

baseline condition The ambient environmental condition existing in the absence of project development. "Future baseline" is a description of conditions that could occur in the future assuming no project development.

bed The bottom of a body of water, such as a stream.

bench cut areas Land cut into terraces for the purpose of riparian zone restoration or to strengthen the design of a water channel.

berm 1) A narrow ledge or path as the top or bottom of a slope, stream bank, or along a beach. 2) (Dam) A horizontal step or bench in the upstream or downstream face of an embankment dam.

Best Management Practices (BMPs) Schedules of activities, prohibition of practices, maintenance procedures, and other practices to prevent or reduce the pollution of waters of the United Sates from discharges of dredged or fill material.

biological assessment A formal examination of the health of a natural community, including air, water, soil, plants, animals, and other organisms.

biostimulatory nutrients Elements such as nitrogen and phosphorus that promote plant and algae growth.

biotechnical bank stabilization areas Sections of a water channel that are strengthened through the introduction of specific plants, trees, and shrubs.

biotic resource Living organisms.

bottom-withdrawal siphon An opening at a low level from a reservoir generally used for emptying or for scouring sediment and sometimes for irrigation releases.

capping the site Constructing a concrete seal around an area to prevent disturbance by development activities.

channel A natural stream that conveys water; a ditch or channel excavated for the flow of water.

channel geometry The structure of a waterway, including the force of water currents, the height and content of banks, and other features.

check structures A small dam or levee constructed in a gully or other small watercourse to decrease the streamflow velocity, minimize channel erosion, promote deposition of sediment, and divert water from a channel.

chinook salmon The largest species of the salmon family. Inhabits the northwest Pacific Ocean and spawns in rivers and streams of North America. The species has a number of races classified by the season in which they migrate into rivers to spawn (e.g., winter run, spring run, fall run, and late-fall run known to occur in California).

Clean Water Act Formally known as the Federal Water Pollution Control Act, it constitutes the basic water pollution control statute for the United States.

cofferdams Temporary structures used to allow construction in water by isolating an area so it can be pumped dry.

coliform bacteria A group of organisms usually found in the colons of animals and humans. The presence of coliform bacteria in water is an indicator of possible pollution by fecal material. Generally reported as colonies per 100 milliliters of sample.

confluence The act of flowing together; the meeting or junction of two or more streams; also, the place where these streams meet.

cost-sharing The apportionment of the cost of water resources studies and projects developed by the Corps that are shared between Federal and non-Federal entities as defined by laws and administrative provisions.

cribwalls A barrier constructed of timber forming bays, boxes, cribs, crossed timbers, gabions, or cells that are filled with earth, stone, or heavy material.

cubic feet per second A measure of a moving volume of water.

cultural resources Any building, site, district, structure, object, data, or other material significant in history, architecture, archeology, or culture.

cumulative effect Two or more individual effects that, when considered together, are considerable or that compound or increase other environmental effects. The individual effects may be changes resulting from a single project or separate projects.

debris loading The amount of material carried in a stream.

degradation The general lowering of the streambed by erosive processes, such as scouring by flowing water; the removal of channel bed materials and downcutting of natural stream channels. Such erosion may initiate degradation of tributary channels, causing damage similar to that attributable to gully erosion and valley trenching.

design flood The flood magnitude selected for use as a criterion in designing flood control works; the largest flood that a given project is designed to pass safely. In dam design and construction, the reservoir inflow-outflow hydrograph used to estimate the spillway discharge capacity requirements and corresponding maximum surcharge elevation in the reservoir.

dissolved oxygen Oxygen dissolved in water that is available to supply oxidation and respiration requirements.

downcutting The erosive effect of water against the river channel; incision.

earthen channel A waterway lined with dirt and rock.

economically feasible a plan that consists of monetary benefits that exceed costs.

ecosystem A recognizable, relatively homogeneous unit that includes organisms, their environment, and all the interactions among them.

endangered or threatened species A species or subspecies of plant or animal whose prospects of survival and reproduction are in immediate jeopardy throughout all or a significant portion of its range.

Endangered Species Act of 1973 (ESA) Federal law that provides protections to plant and animal species determined to be in danger of extinction.

environmental assessment (EA) A concise public document that analyzes the environmental effects of a proposed Federal action and provides sufficient evidence to determine the level of significance of the effects.

environmental impact report (EIR) A detailed written statement, required by the California Environmental Quality Act, similar to the environmental impact statement.

environmental impact statement (EIS) A detailed written statement, required by Section 102(2)(c) of the National Environmental Policy Act, analyzing the environmental effects of a proposed action, adverse effects that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance of long-term productivity, and any irreversible and irretrievable commitment of resources.

erosion The wearing away of land surface by running water, including rainfall, waves and currents, glacier ice, or wind.

estuarine Pertaining to an estuary; a water passage where ocean water mixes with river water.

exceedance probability event The probability that a specific event will be equaled or exceeded in any given year. For example, the 0.01 exceedance probability event has 1 chance in 100 of occurring in any given year.

existing conditions A description of the baseline or existing environmental conditions in the study area including a complete discussion of environmental resources, public facilities, and land uses.

federally authorized Actions that conform to Federal standards and codes or that are initiated by Federal legislation.

Federal Register The official daily publication for Rules, Proposed Rules, and Notices of Federal agencies and organizations as well as Executive Orders and other Presidential Documents.

financial capability The statement of financial capability is a clear and convincing description, submitted by the non-Federal sponsor, of its capability to meet its financial obligations for the project in accordance with the project funding schedule.

Finding of No Significant Impact (FONSI) A public document that briefly presents the reasons why an action would not have a significant effect on the human environment and therefore will not require the preparation of an environmental impact statement.

first costs Engineering design, plans and specification, construction, material, land, environmental mitigation, and miscellaneous costs.

fish passage facilities Structures intended to allow or enhance the movement of anadromous fish in their upstream and downstream migrations past dams and other barriers; includes fish ladders, bypass pipelines, and associated structures.

flood plain Land that may be submerged by floodwaters.

floodway The channel of a river or other watercourse and the adjacent land area that must be reserved to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

fluvial Of or pertaining to rivers.

Folsom flood management plan Section 9159 of the 1993 Defense Appropriations Act directed the Secretaries of the Army and Interior to jointly develop and implement a flood management plan for the American River and Folsom Dam that would ensure prompt, reliable, and full use of the flood control capability at Folsom Dam.

fry (fisheries) An early life stage of anadromous species comprising newly hatched fish less that 50 millimeters long that begin a distinct downstream movement toward the ocean.

freeboard Freeboard protects dams and embankments from overflow caused by wind-induced tides and waves. It is defined as the vertical distance between the crest of a dam and some specified pool level, usually the normal operating level or the maximum flood level. Depending on the importance of the structure, the amount of freeboard will vary in order to maintain structural integrity and the estimated cost of repairing dams resulting from overtopping. Riprap or other types of slope are provided within the freeboard to control erosion that may occur even without overtopping.

gabions A wire cage, usually rectangular, filled with cobbles and used as a component for water control structures or for channel and bank protection.

gaging weir A particular structure on a stream, canal, lake, or reservoir where systematic observations of gage height or discharge are obtained.

geomorphic; geomorphology That branch of geology that deals with the composition and structure of the earth's surface.

gradient control structures Structures such as weirs and dams that alter the slope of a waterway as it descends.

groundwater Any subsurface water from which wells are supplied. **"**Underground water" and "groundwater" are synonymous.

habitat The place where an animal or plant normally lives, among its associated species and support systems, often characterized by a dominant plant and codominant form, such as pinyon-juniper habitat.

habitat degradation The destruction of natural elements necessary to support native species.

habitat evaluation procedure (HEP) A method for analyzing effects on wildlife resources that models the preproject and postproject quality and quantity of habitats for a set of species selected to represent all wildlife.

habitat fragmentation Separating critical natural features from each other such that they become less useful to the animals or plants that occupy them.

hazardous materials Raw materials and products that, because of their quantity, concentration, or physical or chemical characteristics, pose a significant present or potential danger to human health and safety or to the environment if released.

heat transfer Any device designed to transfer heat from one medium to another, often employing water as an agent.

hydraulics Study of the practical effects and control of moving water; used to refer to the relationship between channel geometry and flow, velocity, and depth of water.

hydrograph A graphic representation or plot of changes in the flow of water or in the elevation of water level plotted against time. A graph showing stage, flow, velocity, or other hydraulic properties of water with respect to time for a particular point on a stream. Hydrographs of wells show the changes in water levels during the period of observation.

incision The process by which water cuts a channel or erodes a bank.

invert The channel bottom.

invert stabilization structures Small weirs placed in the natural river channel to reduce the river grade, trap sediments, and create gravel bars and other in-channel habitat.

invertebrates Organisms that lack a spinal column; includes mollusks, crustaceans, insects, starfish, jellyfish, sponges, and many types of worms.

investment costs First cost plus interest incurred during construction of a project.

jurisdictional wetlands Waters of the United States; waters regulated by the Clean Water Act.

larvae Plural of "larva." The early form of an animal, such as a frog or insect, as it develops away from its birth form and begins to take on adult characteristics.

letter of intent Specifies the respective non-Federal sponsors' willingness to meet their financial and other obligations to implement a study or project.

level of protection A measure in years of the average interval between failures of a flood prevention system such as a levee.

listed species Species, including subspecies, of fish, wildlife, or plants listed at 50 CFR Section 17.11 and Section 17.12 as either endangered or threatened or species declared threatened or endangered by the California Fish and Game Commission, including steelhead and California red-legged frog.

Local financing plan Formation of a local financing mechanism by a city or county to fund capital or operations and maintenance of public improvements.

locally preferred plan Local interests may prefer a plan that differs from the NED plan even though sufficient justification for full Federal participation cannot be developed. The incremental cost difference between the Federally supportable plan (NED) and the locally preferred plan are entirely a non-Federal responsibility.

maintenance flow A level of stream flow established by streamflow control devices expected to result in aquatic species survival despite seasonal fluctuations in precipitation and stream recharge.

mitigation To moderate, reduce, alleviate the effects of a proposed activity; includes in order: a) avoiding the effect by not taking a certain action or parts of an action; b) minimizing effects by limiting the degree or magnitude of the action and its implementation; c) rectifying the effect by repairing, rehabilitating, or restoring the affected environment; d) reducing or eliminating the effect over time by preservation and maintenance operations during the life of the action; and e) compensating for the effect by replacing or providing substitute resources or environments.

National Environmental Policy Act (NEPA) Federal legislation that establishes environmental policy for the nation. It provides an interdisciplinary framework for Federal agencies to prevent environmental damage and contains "action-forcing" procedures to ensure that Federal agency decisionmakers take environmental factors into account.

National Register of Historic Places (NRHP) A register of districts, sites, buildings, structures, and objects significant in American history, architecture, archeology, and culture, maintained by the Secretary of the Interior.

natural community conservation plan (NCCP) A plan prepared under the Natural Community Conservation Planning Act (Fish and Game Code Section 2800 et seq.) that identifies and provides for the regional or areawide protection and perpetuation of natural wildlife diversity while allowing compatible and appropriate development and growth.

natural movement corridors Wildlife habitat areas through which species naturally migrate during periods of the day or seasons of the year.

natural recruitment The proliferation of a plant species by natural means, such as seeds being broadcast from fruit trees or acorns from oaks.

NCCP habitat or habitat type Broad habitat categories, each of which includes habitat or vegetation types recognized in frequently used classification systems. The 18 NCCP habitats in the Multi-species Conservation Strategy include tidal perennial aquatic, valley riverine aquatic, montane riverine aquatic, and lacustrine.

No-Action Alternative The future without-project condition. Representative of without-project conditions. Serves as the baseline against which the costs, benefits, and effects of the plans are evaluated. Under this alternative, no action would be taken to implement a specific plan to increase flood protection along the American River beyond that which is already authorized

noise-sensitive receptors People who work or live within hearing range of sounds produced by the project.

nonnative species Wildlife species introduced to an area from somewhere else, often resulting in destructive consequences for native species.

objective release Releases resulting in a flow that may be sustained without risk of levee failure.

offsite mitigation area An area away from the project site where habitat may be restored or protected as mitigation for project effects.

OMRR&R The operation, maintenance, repair, replacement and rehabilitation of the entire project or a functional portion of the project by the non-Federal sponsor at no cost to the Government.

100-year flood A median flood discharge having a 1 percent chance of being equaled or exceeded in any given year.

parapet wall A low, protective wall

peak flows The maximum discharge of a stream during a specified period of time.

PED Preconstruction, engineering, and design.

percolation pond A pond constructed for the purpose of returning water to an aquifer by infiltration into the soil.

photosynthesis Production of oxygen by aquatic algae and plants.

plunge pools and gravel bar sequences Slow- and fast-moving sections of a waterway necessary for anadromous fish spawning.

PM10 emissions Emissions that contain suspended particulate matter greater than or equal to 10 micrometers in diameter. PM10 emissions are generated by a wide variety of sources, including agricultural, industrial, and vehicular activities.

probable maximum flood (PMF) The largest flood that can reasonably be expected to occur.

recharge (hydrology) The introduction of surface water or groundwater to groundwater storage, such as an aquifer.

reconnaissance-level analysis Drawing conclusions based on direct site observation.

records search; literature review Examining all available county and governmental records relating to the property or land feature in question to collect a complete history of development for the subject in question.

redd A type of fish spawning area associated with flowing water and clean gravel.

riffles Shallow rapids in an open stream where the water surface is broken into waves by obstructions such as sandbars or gravel.

riparian Pertaining to the banks of a river, stream, waterway, or other, typically, flowing body of water, as well as to plant and animal communities along such bodies of water.

riparian habitat Woody vegetation, trees, and shrubs that grow in soils saturated for a substantial portion of the year, especially on the edges of open water bodies (e.g., lakes, rivers, or ditches) or on levees.

riprap A lightweight stone covering used to protect soil or surfaces from erosion by water or the elements.

ruderal vegetation A disturbed area that has been allowed to become revegetated naturally.

salmonid Any of a large family of fish similar to salmon or trout that have three vertebrae upturned.

scoping The process of determining the scope, focus, and content of an EIS/EIR and assists the lead agencies in determining the substantive issues to be addressed in an EIS/EIR. The purposes of scoping are to help identify the range of actions, alternatives, and environmental effects to be evaluated in depth in the document and to bring together interested governmental agencies, project sponsors, and other interested parties to discuss and help resolve concerns.

scour The erosive action of running water in streams, carrying away material from bed and banks.

sediment balance The relative difference between erosion and deposition in any given river segment. The sediment balance reflects the net change in erosion and deposition, usually measured by numerical analyses.

sediment load The amount of material a stream is carrying at a given time.

sedimentation The process by which rock and organic materials settle out of water.

separable element A portion of a flood control plan that may be separated out, without compromising the viability of the remaining plan.

shaded riverine aquatic (SRA) cover Provides habitat complexity and diversity in the form of instream cover and a source of food for young fish, and has been defined as: 1) the adjacent bank composed of naturally erodible material, 2) riparian vegetation that either overhangs or protrudes into the water, and 3) the water containing variable amounts of woody debris (e.g., logs, branches, and roots).

simulation The application of a mathematical representation or model to analyze a theoretical or physical process.

smolt A young salmon or steelhead ready to migrate to the ocean after growing to sufficient age and size.

smoltification The process by which salmon fry develop characteristics that allow them to live in saltwater.

solubility The capacity of a substance to dissolve in water.

spawn Laying of eggs, especially by fish.

spawning gravel Rocks and pebbles deposited in streambeds that are just the right size for anadromous fish to move about as they lay their eggs.

special-status species Plant and wildlife species that are federally listed, proposed for listing, or candidates for listing as threatened or endangered under the Federal or California Endangered Species Act.

steady flow Constant river flow.

stream channel geometry The shape of a water channel, including the height, width, and slope of its banks.

subsidence The settling of land attributable to the compaction of soil caused by loading, oxidation of organic soils, removal of underground fluids, or other mechanisms.

take In general, killing of, damage to, or harassment of individuals of a protected species. Under the Federal Endangered Species Act, the definition includes the following activities, which are prohibited with regard to special-status species: harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or any attempt to engage in any of these specifically enumerated activities. Under the Endangered Species Act, therefore, harassment and harm have been extended to include activities that affect habitat that supports listed species.

terrestrial A description of habitat or plant or wildlife species that live on or grow from land.

thalweg The line of maximum depth in the channel.

thermal suitability indicator A part of a habitat that can be measured as an indication of the habitat's ability to support a species.

toe 1) The downstream edge at the base of a dam, 2) the line of a natural or fill slope where it intersects the natural ground.

toe berm The section projecting at the base of a dam, levee, or retaining wall.

turbidity The reduction of light transmission in water caused primarily by the suspension of clays, silts, and other fine materials.

unsteady flow Variable riverflow.

upland habitat Habitat in areas not inundated with water.

vanes A structure in a waterway that diverts water in a particular direction.

vegetation community A group of plant species commonly occurring together in roughly similar proportions.

vortex rock weirs A weir constructed so that water flows from a small opening at its base, causing the water to form a whirlpool as it collects behind the weir.

watershed The area of a landscape from which surface runoff flows to a given point; a drainage basin.

weir A dam, wall, screen, or other structure in a waterway for the purpose of storing, diverting, screening, or measuring water.

wetland Transitional lands between terrestrial and aquatic areas, such as marshes, intertidal mudflats, and wet meadows, where the water table is usually at or near the surface or the ground is covered by shallow water. Wetlands can be freshwater areas, saltwater areas, or a mixture of both. The U.S. Fish and Wildlife Service helps to increase the amount of wetlands by providing incentives for farmers to flood fields and acquiring more dependable water supplies for Central Valley wildlife refuges.

Determining Risk and Uncertainty

Risk and uncertainty are intrinsic in water resources planning and design. They arise from measurement errors and the inherent variability of complex physical, social, and economic situations. All measured or estimated values in project planning and design are to various degrees inaccurate. Invariably the "true" values are different from any single, point values presently used in project formulation, evaluation, and design.

The Corps of Engineers develops best estimates of key variables, factors, parameters, and data components in the planning and design of flood damage reduction projects. These estimates are considered the "most likely" values. They are frequently based on short periods of record, small sample sizes, measurements subject to error, and innate residual variability in estimating methods. Sensitivity analysis has been the primary tool for considering uncertainty in project planning and design. Sensitivity analysis, however, frequently presumes that the appropriate range of values is identified and that all values in that range are equally likely. In addition, the results of this analysis are typically reported as a single, most likely value that is treated by some as if it were perfectly accurate.

Risk-based analyses can be advantageously applied to a variety of water resources planning and design problems. The approach captures and quantifies the extent of the risk and uncertainty in the various planning and design components of an investment project. The total effect of risk and uncertainty on the project's design and economic viability can be examined and conscious decisions made reflecting an explicit tradeoff between risks and costs. Risk-based analysis can be used to compare plans in terms of the likelihood and variability of their physical performance, economic success, and residual risks.

The Corps requires the use of risk-based analysis procedures in the formulation and evaluation of flood damage reduction measures. Risk-based analysis is used because uncertainty exists in the numerical values used to formulate and evaluate alternative measures. Risk-based analysis takes the uncertainty into account before project performance or project benefits are quantified.

The planning and design of flood damage reduction projects require establishing the relationships between flow frequency, water surface elevation, and flood damage. These relationships are determined mathematically using best estimates of key variables, factors, parameters, and other data. The resulting curves determine project performance and benefits. A level of certainty can be defined for each relationship. For instance, if there are detailed flow data and a long period of record for a given stream, the stream's flow frequency relationship will likely be well understood, and the uncertainty for that stream would be less than that for another stream with fewer or questionable data.

A Monte Carlo simulation, based on generating values of key variables through repeated random selection, is used to figure flood risk using uncertainty bounds. The simulation generates floods that result in a series of water surfaces that are compared to levee height and geotechnical strength. The simulation therefore results in a probability of levee failure, flooding, and damage. A graphic presentation of a Monte Carlo simulation is included as **Plate G-1**.

When this kind of analysis is used, the flood risk associated with a system of detention basins, channels, and levees is described in three ways: (1) the expected annual probability of alternative being exceeded (e.g., a 0.01 chance of being exceeded, also expressed as a 1-percent chance); (2) the equivalent long-term risk of exceedance over 10, 20, and 50 years; and (3) the conditional probability of nonexceedance of specified events. (e.g., a 90-percent chance of nonexceedance for a flood with a 1-in-100 chance of occurring in any year). This third way of expressing risk is called "conditional probability of design nonexceedance" but is referred to in this report as system performance. It is important to note that the probability of system exceedance and flooding in any year is not equivalent to the traditional understanding of level of protection. The phrase *level of protection* implies that the system would not fail up to a well-defined flood event that occurs at a certain frequency. In contrast, risk and uncertainty use probability to estimate flood damage reduction because there is uncertainty as to how frequently a particular flood could occur; there also is uncertainty regarding the ability of a system to contain given flood events because of the extent of unknown variables about the structure of the subject levees.